

# Analyzing the Problems Women Face STEM Fields and Computer Science Environments

Lucy Paul and Levi Banos

## INTRODUCTION

We studied the issues that women face in STEM fields and Computer Science environments. Our research pair is composed of two seniors, a Salvadoran person and a Woman, both majoring in computer science at VT with minors in Mathematics. We feel that it is important to devote time to research how we can address discrepancies in our majors and careers in STEM. The field as we have experienced it had an unhealthy competitive nature and was dismissive of the contributions of minorities, women and members of the LGBT community. We wanted to understand how to better communicate our experiences to people who may not have had similar experiences. We used interviews from prominent scientists, recent demographics from various engineering schools, articles published in journals, books, and dissertations to understand the historical impact and the experiences of women and minorities.

Through a critical analysis of media through the form of YouTube and TikTok videos we found that women were leaving their careers because they felt they had to mask their identities, received unfair criticism and had their contributions diminished or made invisible. Additionally, we found that these experiences and feelings are shared by members of other underrepresented groups, and that an intercultural education of each other's experiences is needed to address these issues.

## METHODS

For this topic we examined primary resources to better understand the issue that women face in STEM fields and also gain deeper insight into how these issues start. Because social media is an easy way for people to connect and share their stories we decided to search TikTok and Youtube for first hand stories from women who are in STEM careers or were previously in STEM careers. On Youtube we searched for topics like “what is it like to be a woman in STEM” and “experiences of women in STEM.” The only criteria we had was that the videos needed to be recent (within the last 5 years) so we could show that these issues are still current. From this we found an abundance of TEDtalks and interviews of women sharing their experiences and advice.

While Youtube provided a lot of insightful sources, it was harder to find data from TikTok. This is because the platform is focused around short videos that get their point across quickly, whereas the topic we are analyzing is very complex and the issues can't be discussed in a few seconds. For collecting data we searched for “women in STEM” and focused on longer videos with more dialogue. To find the connecting themes between the videos we created a rainbow data analysis chart. As we watched each video, we would note important themes in the left column and then color in the spots where other videos talked about the same theme.

## LITERATURE REVIEW

A noticeable trend about previous research is that an intersectional approach to minimizing discrepancies is necessary. Interdisciplinary education and giving an encouraging environment is what keeps people in the industry. Better interaction and communication would result in a better understanding of the experiences of others and improve interpersonal skills.

Women experience exclusion, erasure of their accomplishments, and feelings of not being understood within the professional and educational spaces of the field. The phenomena has been well documented beginning with interviews of women who worked on the ENIAC machine, the first digital programmable digital computer, by Tropp (1973), and extending to all the way to the women who founded the Association for Computing Machinery (ACM) and the American Association for the Advancement of Science, both prominent journals in the field of science today (Misa, T.J., 2021). Computer science developed rapidly in the west during WWII; It was closely associated with the masculine culture the American military had. This created a gendered space that feels unwelcoming to women (Mellström, 2009).

This in turn extends to a bias against femininity as shown in studies on students in concentrations where there is no gender disparity such as biomedical engineering. In these studies, it is thought that even though there is no population disparity, male students are still seen as having more desirable academic traits and seen as smarter. (Bloodhart, B et al, 2020) Several women were reported to have had feelings of 'not belonging' or feeling like they are not adequate. Forty percent of women are expected to leave these fields because of lack of opportunities for the advancement of their careers (Tropp, 1999). Meanwhile it is rarely the case that this erasure and unfair criticism is understood as the reason for their departure from this sector, or the reason why women avoid the industry in the first place.

These critiques extend to people who are simply not male, such as transgender and non-binary peoples reporting that similar experiences to that of women (Rodríguez-Pérez, 2021). Furthermore, it is shown that these same factors affecting gender groups also affect racial minorities (McCurdy, 2020). The same environmental factors, and lack of social equity creates a similar environment of erasure and exclusion with few role models to look up to.

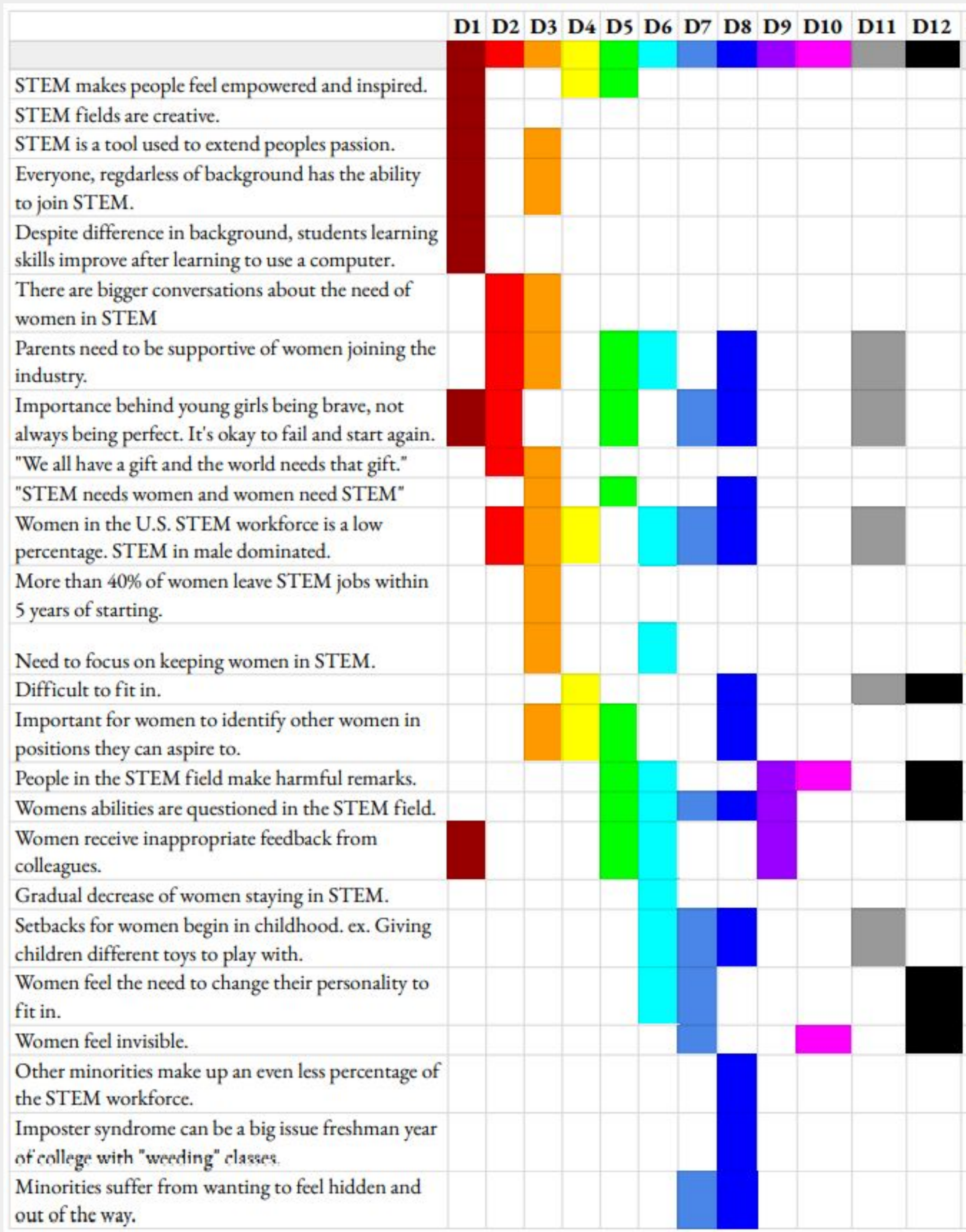


Figure 1: Rainbow spreadsheet to show the connection between the videos

## RESULTS

From the videos we discovered many issues we weren't aware of before and noticed many common themes that connected the experiences of all women in STEM. The three main themes we found were

- Women feel invisible and like they need to change their personality to fit in
- Low percentage of Women in the STEM workforce
- Womens abilities are constantly questioned

These are just a handful of the issues and setbacks that women face in the workplace. The first major pattern we saw was that oftentimes identity isn't discussed in the workplace and this is causing minority groups to feel left out because their identities are being ignored or otherwise made to be invisible. This is more prevalent in minority groups that feel the need to “hide” or “stay out of the way.” (Kori Maria)

The second big theme we noticed was that more girls are going into STEM careers, but then aren't staying in them. A few of the videos called this the “leaky pipe” or “leaking bucket” issue. This is why about 50% of the people in STEM undergraduate degree programs are women, but women only make up about 28% of the STEM workforce. (*Why do so many women leave their careers in STEM?*)

The last major commonality between the videos was that women were constantly finding their abilities questioned by coworkers, colleagues, and even friends. This sometimes resulted in “imposter syndrome.” In one video, a previous professor of a math class recounts the time when a student came into her office hours and mistook another student as the professor because they didn't believe that she was the professor. ( *The Hidden Women of STEM*) Finding all of these themes and patterns helped us understand the negative aspects of this environment with more clarity.

## CONCLUSION

We found many points of data that validated our experiences and feelings towards the STEM and Computer Science fields. The recent tellings of the first hand experiences of women in STEM show that this issue is still very relevant even after the progress that has been made to get more girls into science, technology, engineering, and math fields. Through our research we learned that the biggest issues are that many women are leaving these fields after a few years because they feel invisible and their abilities are constantly questioned.

While an issue as big as this one can feel overwhelming and impossible to overcome, many women offered support and solutions. Most of them agreed on the need for role models, support, and acceptance. If women have role models to look up to they might be more inspired to stay in STEM fields. Encouraging young girls to be brave and providing them with support systems will help get more girls into STEM. Finally, women and other minorities should stop hiding their personalities to try to “fit in”.

One way to provide support and role models is with organizations like the Women in Scholarship, Engineering, Science, and Technology (WISEST) program. These programs are working to increase the number of underrepresented and marginalized groups participating in STEM careers. (Margaret-Ann Armour and WISEST) Taking these steps and providing these programs move us closer to understanding and improving the issues that women face in STEM fields.

## FIGURES

Undergrad Engineering Demographics

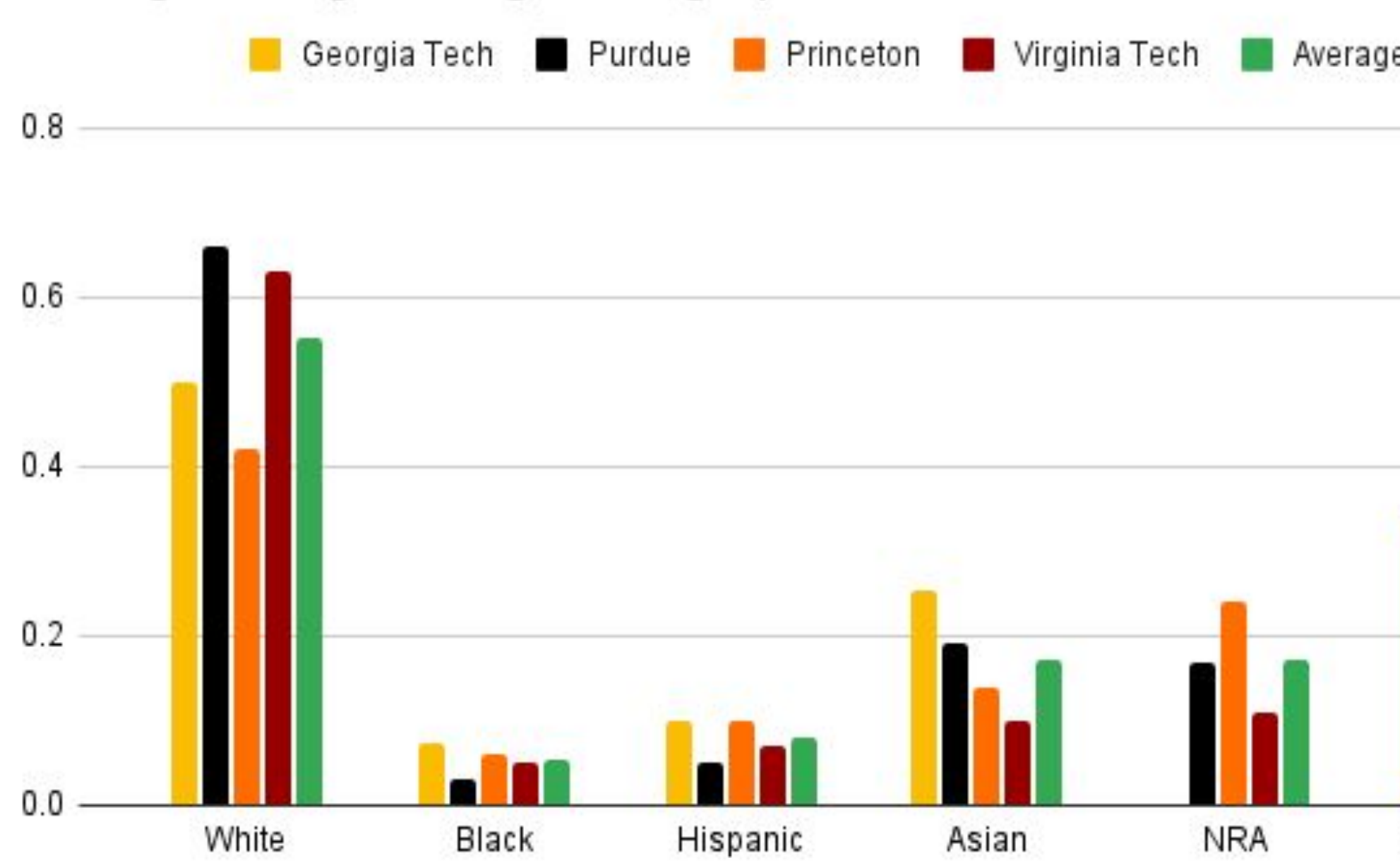


Figure 2\*: Population demographics from prominent American engineering schools

\*Figures obtained from US census data and publicly available demographics from all universities referenced

Virginia Tech, US Undergraduate, and American Demographics

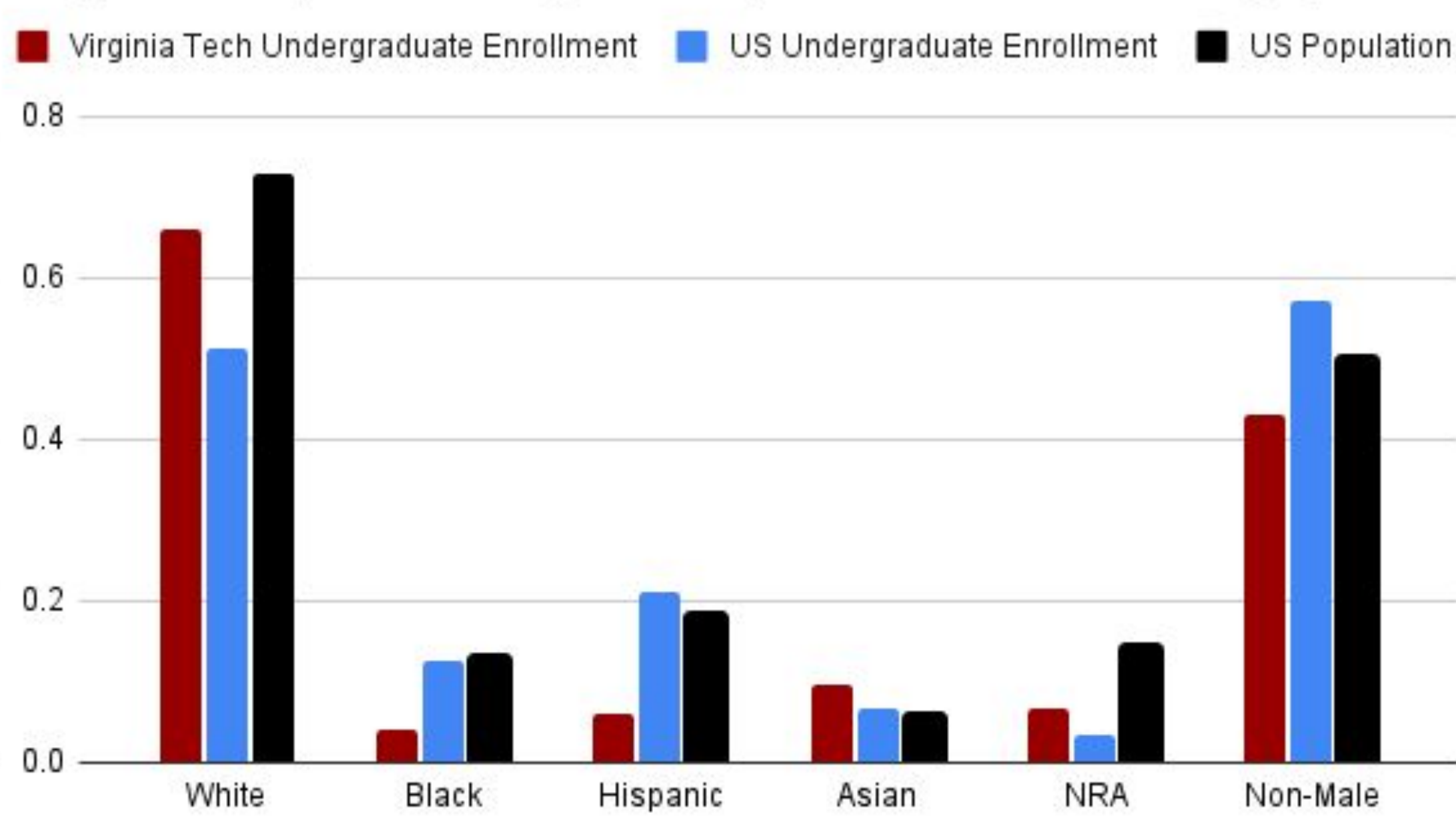


Figure 3\*: Population demographics from Virginia Tech & US Census data

## DISCUSSION

After connecting the themes in the videos and noticing new patterns we discovered some important findings. The biggest findings include:

- Young women need relatable role models to look up to
- Parents and teachers need to be supportive of women joining the industry
- It's important for young girls to be brave and bold
- Women and minorities need to stop hiding their personalities to try and “fit in” with their colleagues

One issue that really stood out to us was the need to focus on keeping women in STEM. Multiple videos mentioned how women leave their STEM careers after just a few years. One possible solution that was brought up multiple times was the need for relatable role models. When women have role models, it motivates them to stay in their career and keep working hard. It's especially important to find role models that have been through the same struggles. (*Why do so many women leave their careers in STEM?*) Having more role models for young girls will also make them more interested in STEM careers.

Another big finding was that it's important for young girls to have a strong support system in their parents, teachers, and friends. When their parents encourage them to follow STEM careers and their teachers help guide them on this path, then there is a higher chance they will follow through with joining the STEM industry. (Cityline)

Finally, we found that it's important for women, and especially minorities, to stop hiding their personalities. An important piece of advice that many of the women gave was that young girls should be brave and bold. By being brave and not “hiding” or “staying out of the way” more women will want to join the STEM workforce and stay. (Cityline) A research article came to a similar conclusion after interviewing multiple LGBT+ scientists. A few agreed that they feel the need to hide part of their identity at their workplaces and this is limiting their career advancements. (Powell, K., Terry, R., & Chen, S.)

## WORKS CITED

- Fervone Goings, Nicole L. Wilson, Ale Equiza, Lianne M. Lefsrud, and Lisa M. Willis. Margaret-Ann Armour and WISEST – an incredible legacy in advancing women in science, technology, engineering, and mathematics (STEM) and the work still to do. *Canadian Journal of Chemistry*. 99(8): 646-652.
- Powell, K., Terry, R., & Chen, S. (2020). How LGBT+ scientists would like to be included and welcomed in STEM workplaces. *Nature*, 586(7831), 813+.
- TEDx Talks. (2022, May 1). *The Hidden Women of STEM* | Alexi Scott | TEDxMountainViewCollege. Youtube.
- TEDx Talks. (2022, May 1). *Why do so many women leave their careers in STEM?* | Prasha Dutta | TEDxWilsonPark. Youtube.
- Kori Maria. (2022, May 1). *The Lack of Diversity in STEM is Disgusting* | My Journey through STEM as a Minority | KoriMaria. Youtube.
- Cityline. (2022, May 1). *What it's really like to be a woman in STEM*. Youtube.
- McCurdy, E. R., (2022 May 1) *Discrimination as a Barrier to Diversity: Sexism and Microaggressions against African American Women in Computer Science and Engineering*. ProQuest Dissertations & Theses Global (2020)
- Rodriguez-Pérez, G., Nadri, R., & Nagappan, M. (2022 May 1) *Perceived diversity in software engineering: a systematic literature review*. *Empir Software Eng* 26, 102 (2021).
- Bloodhart B, Balgopal MM, Casper AMA, Sample McMeeking LB, Fischer EV (2022 May 1) *Outperforming yet undervalued: Undergraduate women in STEM*. *PLoS ONE* 15(6): e0234685. (2020)
- Misa, T.J., (2022 May 1) *Dynamics of gender bias in computing*. *Communications of the ACM Volume* 64 Issue 6 (2021)
- Tropp, H.S., Jean J. Bartik (1924-) and Frances E. (Betty) (2022 May 1) *Snyder Holberton interview: April 27, 1973*. Smithsonian Institution Press (1999)
- Mellström, U., (2022 May 1) *The Intersection of Gender, Race and Cultural Boundaries, or Why is Computer Science in Malaysia Dominated by Women?*. *Sage Journals Vol* 39, Issue 6 (2009)